

Economic Analysis High Pressure Turbine Dense Pack Modification

Approximately two years ago, Alstom came to Intermountain and presented information on a proposed renovation of the high pressure turbines. GE has subsequently also contacted us regarding the same modification.

The proposed modification involves changing the existing double-flow hp nozzle box to a single flow design. By doing this they are able to add stages to the hp turbine and increase hp section efficiency. Both Alstom and GE claim to have data from installed units showing an increase in turbine efficiency (decrease in flow to achieve the same output) of at least 2.0%.

The modification will be a performance contract including pre- and post-installation testing on the hp turbine section for contract validation. The following economic analysis is provided for both performance benefits and increased generation capacity.

Economic assumptions:

1- Economic life:	20 years (PV of Annuity Factor 11.2)
2- Hours of operation/year:	7884 (8760hrs/yr)(0.9capacity factor)
3- Cost of money:	6.35%
4- Cost of generation:	\$42,000/ unit hour (\$48.00/MW hr)
5- Avoided cost of maintenance during 2002 outage:	\$708,000
6- Avoided cost of lost generation to rehab the hp nozzle:	\$1,944,000 (3 days of estimated 10 required)
7- Environmental cost of SCR addition:	\$85,000,000/unit
8- Modifications to balance of plant at maximum flow:	\$6,000,000/unit
9- High pressure turbine section retrofit:	\$4,700,000/unit

Additional Generation Capacity at Existing Steam Flow:

Additional potential revenue (20MW)(\$48.00/MW hr)(7884 hrs/yr)	=	\$7,568,640
Payback: $\frac{\$2,048,000 \text{ (Item 9 - Items 5\&6)}}{\$7,568,640}$	=	0.27 years
Cost/ Benefit Ratio: $(7,568,640)(11.2)/(2,048,000)$	=	41.4

Additional Generation Capacity at Maximum Steam Flow (including environmental costs):

Additional potential revenue (50MW)(\$48.00/MW hr)(7884 hrs/yr)	=	\$18,921,600
Payback: $\frac{\$95,700,000 \text{ (Items 7+8+9 - Items 5\&6)}}{\$18,921,600}$	=	5.06 years
Cost/ Benefit Ratio: $(\$18,921,600)(11.2)/(\$95,700,000)$	=	2.21

Performance Improvement at 875MW:

Fuel Savings (2.25%)(6.3MMlb/hr steam flow)(916 BTU/lb)(1/.88 boiler eff.) (\$1.51/MMBTU)(7884hrs/yr)	=	\$1,756,546 (\$2,873,165 @ 1500 BTU/Lb)
$0.0225(6500 \text{ } \$_{kwh})(830,000 \text{ kw})\left(\frac{\$1.51}{10^6 \text{ Btu}}\right)\left(\frac{8760 \text{ hr}}{\text{yr}}\right)(.90 \text{ eff}) = \$2,112,000/\text{yr}$	=	
Payback: $\frac{\$2,048,000}{\$1,756,546}$	=	1.16 years (.71 years)

Cost/Benefit Ratio: $(\$1,756,546 \times 11.2)/(2,048,000)$	=	9.60 (15.71)
---	---	--------------